

United States
Department of
Agriculture

ACTION PLAN

CHRYSANTHEMUM WHITE RUST DISEASE
Puccinia horiana P. Henn.

Animal and
Plant Health
Inspection
Service

Plant Protection
and Quarantine

Emergency
Programs

Cooperating State
Departments of
Agriculture

This PPQ Action Plan or New Pest Response Guideline has not been updated since its publication date. The actions or guidelines recommended may not be appropriate now, new survey tools may be available, and chemical pesticides named may no longer be registered. This documents is posted until updated versions can be drafted and as such are only guidelines that represent the state of knowledge at the time they were written. Please consult PPQ and/or your State Plant Regulatory Official prior to implementing any recommendations listed herein.

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AUTHORIZATION

This Action Plan provides guidelines and actions for the eradication of Puccinia horiana, the cause of chrysanthemum white rust disease.

It is to be used in conjunction with other manuals when conducting emergency program activities. The information and instructions contained in this Action Plan were developed with and approved by representatives of cooperating States, the U.S. Department of Agriculture's Agricultural Research and Cooperative State Research Services, and affected industry.

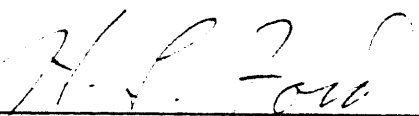
All program technology and methodology employed is determined through discussion, consultation, or agreement with the cooperating State officials.

NOTICE

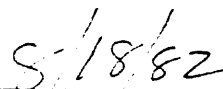
Recommendations in this Action Plan which involve the use of pesticides concern products which are registered or exempted under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Precautions on the pesticide label and all instructions in this Action Plan must be carefully followed.

Federal and/or State personnel may not make any warranty or representations, expressed or implied, concerning the use of these products and shall not be responsible for any loss, damage, or injury sustained as a result of the use of any product as specified in this Action Plan.

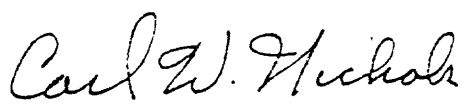
The use of trade names in this Action Plan does not imply an endorsement of those products or of the manufacturers thereof by Federal-State pest control programs.



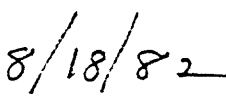
Deputy Administrator
Plant Protection and Quarantine



Date



Chairman
National Plant Board



Date

I. GENERAL INFORMATION

A. Action Statement

The information contained in this document is intended for use only when an outbreak of chrysanthemum white rust disease is known to exist. This Action Plan is to be used for guidance in implementing eradication procedures and in preventing spread of the disease to other locations. This Action Plan provides technical and general information needed to implement any phase of a chrysanthemum white rust disease eradication program. Specific emergency program action is to be based on information available at that time.

B. Background Information

Chrysanthemum white rust is one of the more serious fungal diseases which threatens this important floral and ornamental crop. Prior to 1963 the disease was known to occur only in Asia. Beginning with an outbreak in England in 1963, the disease spread rapidly and it is now found throughout Europe as well as in South Africa and South America. In 1977-78 there was an outbreak of chrysanthemum white rust in New York, New Jersey, and Pennsylvania. Prompt action by Federal and State authorities prevented the spread of the disease from the 15 hobbyist plantings in which it was initially found. There have been no reports of chrysanthemum white rust in the United States since its eradication in 1978.

The florist chrysanthemum (Chrysanthemum morifolium) is the only widely grown host species. At least 11 other Chrysanthemum species may serve as hosts, but none of these are widely planted or commercially important in North America. The most common symptoms on infected plants are pale yellowish spots on the upper surface of leaves. With age, the spots turn brown and become necrotic. Telia form on the undersides of leaves. The telia are at first buff to pinkish in color, later becoming white. Infection is most common on leaves, but can occur on any green part of the plant. A related disease, chrysanthemum common rust (Puccinia tanacetii), is widely distributed in the United States. The two rusts produce somewhat different symptoms and when identification in the field is a problem the species may easily be distinguished on the basis of microscopic characteristics.

Puccinia horiana is a microcyclic rust. The pathogen is only known to produce teliospores and basidiospores. No alternate hosts are known to exist. When conditions of high humidity and temperatures in the 13° C. to 24° C. (55° F. to 75° F.) range are present, teliospores germinate 6 to 12 days after they are formed on infected leaves. The germinating teliospores produce basidiospores which can produce new infections after being dispersed by wind or splashing water. Teliospores are

transported short distances by splashing water or over longer distances through their movement on host plants.

Puccinia horiana may overwinter as mycelium in the green tissue of plants in greenhouses or outside where winters are mild or where plants are protected by mulch. Since the teliospores do not survive beyond 8 weeks, the disease is not likely to be perpetuated outdoors in the cooler areas (plant hardiness zones 1 and 2) of the United States.

D. Program
Staffing
and Respon-
sibilities

At the outset of the project, the PPQ National Regional Director and the chief official designated by the State in which the infestation occurs, in consultation with the Emergency Programs Coordinator, will select the project manager. The project manager will organize the management structure, establish operational protocol, act as liaison with cooperators, select key personnel, develop personnel rotational schedules, develop lists of contacts and cooperators, mobilize emergency equipment and inventory supplies, and identify preliminary technical support needs. In addition, the project manager will be responsible for overall project and administrative functions. Each section head reports directly to the project manager.

PPQ personnel will first be enlisted from those available in the affected region. If the emergency project progresses in scope beyond regional personnel availability, additional personnel will be drawn from the Preparedness for Emergency Plant Pest Actions (PEPPA) cadre. Initial staffing will be comprised of two basic units--administrative and program operations. These units will coordinate their efforts simultaneously to address the immediate project staffing needs and responsibilities.

1. Program Operations

a. Project Manager

- (1) Establishes a base of operations.
- (2) Organizes management structure.
- (3) Establishes operational protocol.
- (4) Acts as liaison with cooperators.
- (5) Selects personnel.
- (6) Mobilizes emergency equipment and inventory supplies.
- (7) Identifies preliminary technical support needs.
- (8) Establishes a daily information report system.

- (9) Maintains chronology of program activities.
- (10) Arranges for notification to concerned individuals, agencies, or groups including:
 - (a) State departments of agriculture.
 - (b) Affected county/city governments.
 - (c) Concerned agricultural industries.
 - (d) Federal and affected State environmental protection agencies.
 - (e) Federal/State extension and research agencies.
 - (f) Food and Agriculture Organization of the United Nations.
 - (g) Concerned foreign governments.
 - (h) General public.
 - (i) Special interest groups.

b. Detection and Survey Officer

- (1) Initiates and implements detection system.
- (2) Arranges for prompt identification services.
- (3) Arranges for facilities and equipment.
- (4) Implements identification procedures and authorization.
- (5) Provides shipment protocol for specimens and handling safeguards.
- (6) Contacts--Cooperators, industry.

c. Regulatory Officer

- (1) Issues emergency action notifications on affected properties.
- (2) Proposes emergency regulations, actions, and boundaries.
- (3) Provides for continuing regulatory action, if needed.
- (4) Notifies affected carriers, agricultural industries, and other industries of regulated articles.
- (5) Notifies State highway departments, weigh stations, etc., as appropriate.
- (6) Notifies public of regulatory program.
- (7) Makes available approved regulatory treatment procedures to all concerned groups.
- (8) Implements quarantine treatments and actions.
- (9) Maintains fumigation facilities.
- (10) Contacts--Cooperators, industry.

d. Control Officer

- (1) Determines appropriate pesticide use, ensures labels are adequate, and if exemptions are required.
- (2) Arranges for pesticide storage and disposal sites.
- (3) Supervises control applications.
- (4) Initiates pesticide residue monitoring program.
- (5) Contacts--Cooperators, industry.

e. Technical Support Representatives

Onsite technical support will include methods development personnel and depending on program complexities could include Agricultural Research and Cooperative State Research Services, industry, extension services, and others.

- (1) Determines field tests and technical information needs.
- (2) Provides for equipment support and development.
- (3) Advises on regulatory treatment technologies.
- (4) Determines adequacy of control technology in field.

Additional personnel and tasks to be considered in an expanded program operation are listed below.

f. Safety Officer

- (1) Determines safety procedures and regulations.
- (2) Identifies safety equipment needs.
- (3) Establishes contacts with poison control centers, hospitals, cooperators, and Federal and State occupational safety and health administrations.
- (4) Provides for safety training.
- (5) Conducts safety inspections.

g. Information and Public Relations Officer

- (1) Contacts--APHIS personnel, cooperators, law enforcement, television, radio, newspapers, magazines, special interest groups, industry, and State and local departments of agriculture.
- (2) Coordinates domestic and foreign visitor activities.

2. Administrative Operations

a. Administrative Officer

Responsible for all administrative support functions.

- (1) Arranges for facilities, space, furniture, and telephones.
- (2) Provides supplies, manuals, and forms.
- (3) Furnishes equipment--automated data processing, word processing, and other communication equipment.
- (4) Provides for badges and identification cards.
- (5) Processes Government travel requests, purchase order invoice vouchers, and travel vouchers.
- (6) Prepares contracts and cooperative agreements.
- (7) Maintains motorpool.
- (8) Maintains imprest fund.
- (9) Maintains liaison with Field Servicing Office.
- (10) Maintains time and attendance records.
- (11) Arranges for travel/hotel reservations.
- (12) Processes claims and handles complaints.
- (13) Establishes and maintains inventory.

b. Data/Graphics Services Officer

- (1) Prepares maps, overlays, charts, signs, and placards.
- (2) Maintains equipment.
- (3) Prepares graphics.
- (4) Manages data acquisition, manipulation, and retrieval.

II. SURVEY PROCEDURES

When surveys are conducted and specimens are collected, confirmation of a suspected detection of chrysanthemum white rust can be provided by designated personnel.

Prior to submitting material for identification, an identifier should be contacted to obtain any clearances required for shipment of infected plant material.

Inspectors should take precautions to prevent the inadvertent spread of the disease. This would include washing hands after visiting any site where the disease is found. When visiting any site where the disease is known or suspected to be present, disposable plastic footwear should be worn.

A. Delimiting Survey

When an outbreak of chrysanthemum white rust disease is confirmed in an area, a delimiting survey will be implemented as soon as possible. The purpose of this survey is to determine the size of the area in which the disease is present and the extent to which the disease has become established. The survey will require the careful examination of all chrysanthemum plants in the designated area, including those being grown in greenhouses. Locations to be inspected will include the following:

1. All chrysanthemum plantings located on any property where the disease is found.
2. All chrysanthemum plantings located within a 1/4 mile (402 meters) radius of a property on which the disease is found.

At locations where chrysanthemums are grown outdoors or in greenhouses, the plants will be inspected every 2 weeks for a period of 4 months.

Surveys will be carried out at all locations that have received chrysanthemum plants or propagating material shipped from the site of an outbreak within a period of up to 1 year. The extent to which these surveys will be required depends on the intended use of the cuttings, flowers, or plants shipped from any establishment where the disease is present. If the plant material was intended for ornamental (florist) use, it is probably not possible to conduct a comprehensive survey, but State regulatory officials will be notified where the products have been shipped. If the plants or cuttings were intended for propagation purposes, the threat of disease spread is more serious. When propagating materials have been sent directly to other growers, delimiting surveys should be conducted at these sites. When the materials were sent to distributors, the distributors

should be alerted to the potential problem. State regulatory officials in the States served by the distributors will be notified.

B. Monitoring/
Evaluation
Survey

The sites will include any property (including greenhouses) that has been subjected to eradication treatments. Surveys should begin with the earliest appearance of green tissue in outdoor plantings or with resumption of chrysanthemum growing in greenhouses. The survey will include a thorough inspection of all chrysanthemum plantings located on the property. Surveys will begin with the appearance of new growth and will be conducted every 2 weeks for a period of 2 months.

C. Detection
Survey

Detection surveys will normally be carried out at any site where there is a reasonable possibility of chrysanthemum white rust having been introduced. The actual site inspection will consist of a thorough examination of all chrysanthemum plants growing in the vicinity of any suspected plant(s) or cuttings. This survey will include the entire property on which chrysanthemums are grown. The inspection will have to be made when plants have a good amount of foliage. In plant hardiness zones 3 through 8, when a detection survey site located outdoors is first identified during the period of late fall through early spring, the inspection should be delayed until good foliage growth has occurred in the spring. Greenhouses should be inspected as soon as possible.

D. Orientation
of Survey
Personnel

New personnel will be trained, on the job, by experienced personnel. Three working days will be necessary to become familiar with the important aspects of chrysanthemum white rust survey.

E. Survey
Records

Records noting the areas surveyed, sites examined, dates, and survey results will be maintained. See Action Plan Addendum E for detailed instructions.

III. REGULATORY PROCEDURES

A. Instructions to Officers

Regulatory actions will be required until the pest is eradicated. Officers must follow instructions for regulatory treatments or other procedures when authorizing the movement of regulated articles. Understanding the instructions and procedures will serve as a basis for explaining such procedures to persons interested in moving articles affected by the quarantine and regulations. Only authorized treatment procedures may be used.

General instructions that are to be followed in regulatory treatment are found in the PPQ Treatment Manual.

Officers may aid shippers in selecting the authorized treatment or procedure that is most practical for the shippers. They should advise the shipper to apply selected treatments to small quantities of material prior to treating larger quantities to determine reaction or effects of treatment procedure. When treating commodities, which are particularly sensitive to the treatments selected, treat more of the commodity than is needed to allow for possible losses.

B. Regulated Articles

1. Plants or plant parts of any of the following Chrysanthemum species:

Common Name

Scientific Name

Nippon daisy
Florists chrysanthemum

High daisy

C. nipponicum
C. morifolium
(syn. C. sinense)
C. uliginosum

No Common Names Available

C. arcticum
C. shiwogiku
C. pacificum
C. makinoi
C. indicum
(syn. C. japonicum)
C. yezoeuse
C. koreanum
C. boreale
C. vosinagathum

2. Soil, planting, or rooting media.

3. Tools and implements used in chrysanthemum cultivation.

4. Any other products, articles, or means of conveyance, of any character whatsoever, when it is determined by an inspector that they present a hazard of spread of chrysanthemum white rust disease and the person in possession thereof has been so notified.

Quarantine Actions

When detections are made, the following steps should be implemented in sequence:

1. Each property on which chrysanthemum white rust is found, or which is identified as a recipient of infected plants, will be subject to emergency action notifications requiring treatment or other approved handling procedures. Emergency Action Notifications (such as PPQ Form 523) and/or a comparable State notifications are issued by field personnel to the property owners or managers of all establishments handling, moving, or processing articles capable of spreading chrysanthemum white rust disease. A notification may be issued pending positive identification and/or further instruction from the Deputy Administrator.
2. If necessary, the Deputy Administrator will issue a letter directing PPQ field offices to initiate specific emergency action under the Federal Plant Pest Act (7 U.S.C. 150dd) until emergency regulations can be published in the Federal Register.

The Federal Plant Pest Act of 1957 provides for authority for emergency quarantine action. This provision is for interstate regulatory action only; intrastate regulatory action is provided under State authority. However, if the Secretary of Agriculture determines that an extraordinary emergency exists and that the measures taken by the State are inadequate, USDA can take intrastate regulatory action provided that the Governor of the State has been consulted and a notice has been published in the Federal Register.

The Organic Act of 1944, as amended, provides the Federal Government, either independently or in cooperation with States or political subdivisions thereof, farmers' associations and similar organizations, and individuals, the authority to carry out operations or measures to detect, eradicate, suppress, control, or to prevent or retard the spread of plant pests. This Act does not provide for trespassing on private property, but relies upon State authority and willingness to use State right-of-entry authority.

All program technology and methodology employed is determined through discussion, consultation, or agreement with the cooperating State officials.

3. The Deputy Administrator, through the National Regional Directors, will notify State cooperators of the chrysanthemum white rust disease detection, actions taken, and actions contemplated.

A description of the regulated area with support documents will be developed by USDA and cooperators and provided to the Regulatory Services Staff, National Program Planning Staff (NPPS).

4. APHIS Regulatory Coordination Staff will publish in the Federal Register emergency regulations under the Federal Plant Pest Act.

5. After a reasonable time, taking into consideration such factors as the biology of the pest, climatic conditions, and infestation spread, a proposal to promulgate a quarantine under the Plant Quarantine Act will be published. The proposal will announce a date for submitting written comments, which shall be approximately 60 days after publication.

6. After receipt of written comments, a final determination specifying the action decided upon will be published in the Federal Register. A quarantine under the Plant Quarantine Act will be enacted if eradication has not been achieved.

D. Use of
Authorized
Chemicals

Addenda C and D of this Action Plan contain the authorized chemicals, methods of application, rates, and any special application instructions. Concurrence by the Emergency Programs staff is necessary for the use of any chemical or procedure for regulatory purposes.

E. Approved
Regulatory
Treatments

1. Regulatory Treatments for Plant Material. There are no approved regulatory treatments which will permit the movement of infected plant material from locations with confirmed infections.

2. Disinfection of Tools, Equipment. Tools and equipment that may have come in contact with infected plants or contaminated soil will be disinfected by dipping in 10 percent active ingredient formaldehyde solution or by washing with steam or high pressure hot water.

3. Rendering Crowns (Stools) Free of Fungal Contamination. Crowns (Stools) of plants to be saved for propagation must be dug up and subjected to a hot water treatment. This treatment involves the complete immersion of the crown in hot water at 46° C (115° F) for at least 5 minutes.

F. Approved
Regulatory
Treatments

1. Destruction of Current Stand/Prohibition on the Movement of Plants. The eradication of P. horiana requires the complete removal and destruction of all flowers and green tissue (leaves, stems, and crowns) from plants of any susceptible Chrysanthemum species on the premises where the outbreak occurred, except as noted below. Plants should be destroyed by incineration, burial in lime pits, or heat treatment.

No plants or plant parts belonging to any susceptible Chrysanthemum species will be removed from any property on which chrysanthemum white rust has been confirmed. This prohibition will remain in effect until the property is determined to be free of the disease, based on the results of monitoring surveys.

Exception: Plants grown on the property in greenhouses or plots that are separate from the area in which the disease is found, may be released from quarantine when:

a. Plants are from facilities which have been decontaminated and which plantings have been reestablished using heat treated or rootstocks certified plants; or

b. Delimiting surveys do not disclose evidence of the disease after a 4-month survey period; and

c. The chemical treatments and environmental modifications (irrigation) required for the establishment of new plantings (see eradication) are strictly followed.

2. Prohibition on the Movement of Soil, Growing, and Rooting Media. No unsterilized soil or bedding material may be removed from any property on which chrysanthemum white rust disease has been found. This prohibition will remain in effect until 2 months after the date the property is determined to be free of the disease, based on the results of monitoring surveys.

G. Principal
Activities

The following are the principal activities necessary for conducting a regulatory program to prevent the spread of chrysanthemum white rust disease.

1. Supervising and monitoring the disinfection of tools, equipment, and buildings that may have come in contact with infected plants.

2. Regulating movement of host materials.

3. Contact visits with:

- (a) Commercial growers, gardeners, and hobbyists.
- (b) Storage and processing facilities.
- (c) Commercial haulers of regulated articles.
- (d) Farm equipment and implement dealers.
- (e) Farm and garden supply dealers.
- (f) Florists and nurseries.

H. Orientation
of Regulatory
Personnel

Only trained or experienced personnel will be utilized initially. Replacement personnel will be trained by the individual being replaced. A training period of 3 working days is necessary for the orderly transfer of these functions.

I. Regulatory
Records

Records will be maintained, as necessary, to carry out an effective, efficient, and responsible regulatory program. See Action Plan Addendum E for detailed instructions.

IV. ERADICATION PROCEDURES

Eradication of a chrysanthemum white rust disease outbreak is essential. The limited host range, the fact that the fungal spores have short survival times and a poor dispersal mechanism, and the fact that the pathogen can only survive in green host tissue make the eradication of this disease feasible. The following sections provide approved eradication procedures available for use in most situations. These procedures include mechanical, chemical, and cultural control or a combination of the three. Local conditions will determine the most appropriate procedure to achieve eradication.

A. Emergency Exemption

Emergency Programs staff, in consultation with methods and research agencies, outlines treatments to be used. Emergency Programs staff must be notified of all treatment plans. If treatments selected or proposed are not in conformance with current pesticide labels, an emergency exemption can be provided under Section 18 of FIFRA, as amended. The regulations for implementing emergency exemptions under Section 18 of the FIFRA were published in the Federal Register (Vol. 38, No. 231, December 3, 1973; 40 CFR 166.1 et seq.). These regulations outline the types of emergency exemptions which may be requested.

Under Section 18 of FIFRA, a Federal or State agency may be exempt from the label requirements provided the Administrator of the Environmental Protection Agency (EPA) determines that an emergency exists which requires such an exemption. An emergency exemption becomes a legal document and is issued instead of a registered label.

Section 18 regulations specify that an emergency exists when: (1) A pest outbreak has or is about to occur, and no pesticide is registered and readily available or no other appropriate method of control is available to eradicate or suppress the pest; (2) significant economic or health problems will occur without the use of the pesticide; and (3) the time available from discovery or prediction of the pest outbreak is insufficient for a pesticide to be registered for the particular use.

Three types of emergency exemptions are provided for under Section 18 regulations: specific, crisis, and quarantine. Pest conditions, program needs, and available pesticides will determine which exemption will be necessary.

Restrictions contained in the exemption provide for protection of the general public and environment. All conditions imposed by the exemption must be met. An emergency exemption may be withdrawn if EPA determines that an agency is not complying with the require-

ments of the exemption or that withdrawal is necessary to protect the environment.

Although an emergency exemption is issued under Section 18 of FIFRA, States are currently the primary enforcement arm for pesticide use. Therefore, any exemption still requires approval by the State in which the pesticide is used.

B. Recommended
Pesticides

1. Oxycarboxin (Plantvax-75W)
2. Bayleton®

C. Approved
Eradication
Treatments

1. Destruction of Current Stand. The eradication of P. horiana requires the complete removal of all flowers and green tissue (leaves, stems, and crowns) from plants of any susceptible Chrysanthemum species on the premises where the outbreak occurred. Plants removed should be destroyed by incineration, burial in lime pits, or heat treatment.

Exception: The complete removal of plants may not be warranted in the case of growers having a number of separate facilities (greenhouses, nurseries, etc.) located on the same property. Removal of plants may be limited to those facilities, where the disease has been confirmed, if delimiting surveys indicate that the outbreak is confined to those facilities. This will require that appropriate regulatory, control, and monitoring steps are taken to protect all other facilities located on the property.

2. Treatment of Rootstocks. If crowns (stools) of any plants are to be saved for propagation, they must be dug up and subjected to hot water treatment. The hot water treatment involves the complete immersion of the stool in hot water at 46° C. (115° F.) for at least 5 minutes. This will destroy all remaining green tissues, and thus eliminate any cryptic fungal mycelium.

3. Interval Before Replanting. After the destruction of the current stand, no susceptible Chrysanthemum species will be planted on the property for 2 months, unless the planting site is a greenhouse facility and it can be rendered free of rust spores by soil sterilization heat treatment and decontamination. Plants may be replanted in sterilized soil if kept indoors.

Moist soil conditions reduce the length of time that teliospores can survive. Soil in plots or beds should be kept watered during the preplanting interval to aid in the destruction of teliospores.

4. Chemical Treatment. On a property where an outbreak has occurred, apply oxycarboxin or Bayleton® as soon as new cuttings

are set or when new plants are 3 inches high to prevent the reoccurrence or establishment of chrysanthemum white rust disease. Plants will be sprayed in such a way that both (upper and lower) leaf surfaces are thoroughly wetted. This fungicide application will be repeated every 2 weeks for a period of 2 months.

5. Environmental Modification. When plantings are reestablished or where plants are retained at facilities located on the property where an outbreak has occurred, steps will be taken to create an environment that will discourage infection.

Since the disease is spread by water splashed spores and since high humidity encourages development of white rust, changes in irrigation practices will be necessary. This could include the elimination of all sprinkler or overhead irrigation and the substitution of flood, drip, or other irrigation methods that minimize water splashing and high humidity. These irrigation methods will be continued for a period of 2 months.

- | | |
|---|--|
| D. Orientation of Eradication/Control Personnel | Only trained and experienced personnel will be utilized initially. Replacement personnel will be trained by the individual being replaced. A training period of 3 working days is necessary for the orderly transfer of these functions. |
| E. Eradication/Control Records | Records noting the location, dates, number and type of treatments, and the materials and formulations used will be maintained for all areas treated. See Action Plan Addendum E for detailed instructions. |
| F. Monitoring | Monitoring will apply to outdoor plantings only. An effective monitoring program will be implemented to aid in the evaluation of program efforts and environmental impact. The application and use of pesticides and other controlled substances will be assessed through the use of appropriate monitoring program criteria. The evaluation must effectively address Agency, cooperator, and public concerns. |

The monitoring program for sampling to evaluate effect on environmental components will include at the minimum the following elements:

1. Water sampling to detect pesticide levels through direct application, leaching, and runoff.
2. Soil sampling to determine pesticide levels and residues.

3. Crops subsequently grown for human and animal food source.

4. Impact of pesticide on nontarget organisms.

The monitoring program is to be a combined effort between the State in which the emergency program is being conducted and PPQ. If specific plans need to be developed for monitoring activities, the Emergency Programs staff will request assistance and guidelines from NPPS.

V. CONTACTS

The success of a chrysanthemum white rust disease eradication project will depend on voluntary cooperation and assistance received from other involved groups. The following lists various groups which must be kept informed of and/or are involved in all operational phases of an emergency program.

- A. Other Federal, State, county, and municipal agricultural officials.
- B. Florist/nursery groups.
- C. Universities.
- D. Foreign agricultural interests.
- E. National, State, and local news media.
- F. State and local law enforcement officials.
- G. General public.
- H. Hobbyist, growers, and organizations.

Addendum A--Definitions

Basidiospore:	A sexually produced spore, one-celled and usually quite fragile.
Bedding Material:	The media in which plants are grown.
Chrysanthemum White Rust:	A disease affecting chrysanthemum foliage, stems and flowers caused by the fungus <u>Puccinia horiana</u> P. Henn.
Confirmed Detection:	Positive laboratory identification by a USDA facility of a submitted sample (specimen) of chrysanthemum white rust disease.
Cryptic:	A fungus growth in a plant that is not apparent.
Decontamination:	The application of an approved chemical or other treatment to contaminated implements, material, or buildings for killing or deactivating the pathogen.
Detection Survey:	A survey conducted in an environmentally favorable area where chrysanthemum white rust disease is not known to occur.
Disease:	Any prolonged disturbance in a plant that interferes with its normal structure or function.
Facility:	Any discrete and detached building or area in which chrysanthemums are grown.
Host:	A plant which is invaded by a parasite and from which the parasite obtains its nutrients.
Incineration:	Any burning of chrysanthemum plants that result in their complete destruction.
Infection:	The establishment of a parasite on or within a host plant.
Inoculation:	The transfer of a pathogen onto a host.
Inoculum:	The pathogen or its parts that can cause disease. The portions of individual pathogens that are brought into contact with the host.

Known Infested Property:	The entire property where the disease is detected including fields on which common equipment and/or machinery is used.
Microcyclic:	The life cycle of a rust fungus that produces only the teliospore and basidiospore stages.
Monitoring/Evaluation Survey:	A survey conducted at a site where a disease was found and where an eradication program is being performed.
Mycelium:	The mass of microscopic strands (hyphae) that make up the body of a fungus.
Outbreak: (Detection Site)	The site where one or more plants affected with chrysanthemum white rust disease are found.
Pathogen:	Any organism that can incite a disease.
PPQ-APHIS-USDA:	Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture.
Propagating Material:	Any plant part used for the vegetative reproduction of chrysanthemums.
Property:	A land unit under one owner or operator that is handled as a single farming or production operation.
Primary Site:	A property on which an initial detection of a disease occurs.
<u>Puccinia horiana</u> P. Henn:	The rust fungus that incites white rust disease in chrysanthemums.
Race:	A pathogen that infects a given set of plant cultivars (varieties).
Regulated Area:	An area including any property where chrysanthemum white rust disease is found.
Rust:	A disease caused by one of the uredinales (rust fungi) and characterized by giving a "rusty" look to infected plants.
Stool:	A root/crown used for the vegetative propagation of new plants.

Telium (pl. Telia):

A fungal structure producing teliospores.

Teliospore:

The sexual, thick-walled spore of rust and smut fungi.

Addendum B--Safety

1. GENERAL INFORMATION

Personnel and public safety must be prime considerations at all times. Safety practices should be stressed in preprogram planning. Supervisors must enforce on-the-job safety procedures.

Pesticides authorized for use vary in toxicity. When used in accordance with label instructions, materials do not constitute a threat to people, wildlife, bee, etc. Specific safety precautions for each pesticide are listed on the label. In addition, any special precautions listed in this manual or specific manuals shall be observed.

Keep pesticides in closed, properly labeled containers in a dry place. Store them where they will not contaminate food or feed and where children and animals cannot reach them.

When handling a pesticide, follow all precautionary labeling.

Should there be contact through spillage, or otherwise, wash immediately with soap and water. Should clothing become contaminated, launder before wearing again. Refer to the PPQ Treatment Manual, Section X, for additional information.

Empty pesticide containers should be disposed of in an approved sanitary landfill, by incinerator, or by other satisfactory methods approved by the Federal Environmental Protection Agency whereby they will not present a hazard or problem. Arrangements for disposal of such containers should be completed and thoroughly understood by all parties directly involved with a program prior to the actual start of operations. PPQ Regional Offices and the NPPS should be consulted for pertinent information in States where operations are conducted.

When applying a pesticide, consider the potential impact of the pesticide on all components of the total environment including humans, crops, livestock, wildlife, aquatic life, nontarget insect species, and domesticated honey bees. Avoid contamination of lakes, streams, ponds or watersheds.

2. FIRST AID SUGGESTIONS

In case of accidental poisoning or as soon as any person shows symptoms of having been affected by any pesticide:

- a. Remove the person to a place where there will be no further contact with the pesticide.
- b. Have the person lie down and keep quiet.
- c. Call a physician and provide the name and formulation of the pesticide in use and first aid given.

- d. The local Poison Control Center telephone number is to be posted where pesticides are stored and used. The number may also be found on the inside front cover of the telephone directory. Call Chemtrex on toll free Area Code (800) 424-9300 for additional assistance in the event of spills, leaks, fires, exposures, accidents, or other chemical emergencies.

3. MANAGING/MONITORING PESTICIDE SPILLS

Supervisors involved in pesticide application must be available and be familiar with "Guidelines for Managing and Monitoring Pesticide Spills," dated March 1981. In addition, the following pesticide spill safety and cleanup equipment must be present at all job sites where pesticides are stored or used.

a. Safety

- (1) First Aid Kit—Bus and truck kit GSA 66545-00-664-5312 (or equivalent)
- (2) Fire extinguisher--5 lb. size for class A, B, C fires
- (3) Portable Eye Wash Kit

b. Cleanup

- (1) Shovel, square-point, "D" handle
- (2) Large heavy duty plastic bages with ties (23)
- (3) Rubber boots (2 pairs)
- (4) Disposable coveralls (4 pairs)
- (5) 5 gallons of water
- (6) Rubber gloves (4 pairs)
- (7) Respirators and pesticide cartridges (2 sets)
- (8) Broom
- (9) Dust pan
- (10) Liquid detergent (1 pint bottle); paper towels
- (11) Scrub brushes (2)
- (12) Plastic cover or tarpaulin to cover dry spills (10' x 12')
- (13) Absorbent material to absorb liquid spills (sand, sawdust, vermiculite, "Kitty Litter," etc.)
- (14) Portable light source

Addendum C--Life History

1. HISTORY AND ECONOMIC IMPORTANCE

White rust disease of chrysanthemum, caused by Puccinia horiana P. Henn., is indigenous to China and Japan. The disease was first reported in Japan in 1895, and the fungus described in 1901.

Chrysanthemum white rust disease seems to have been confined to the Asian Continent and Australia until 1963, when an outbreak was reported in England. During the decade of the sixties, the disease spread to most European countries and now is established in a number of countries throughout the world.

The first verified report of white rust infecting chrysanthemums in the United States was in 1977-1978, when the disease was observed in 15 locations in New York, New Jersey, and Pennsylvania. In all cases, the disease was confined to hobbyist plantings and was never found in association with commercial cut or potted flower establishments. A vigorous program, conducted by State departments of agriculture and PPQ, resulted in the complete eradication of the disease in the United States. There have been no verified reports of the disease in this country since 1978.

In 1978 the commercial chrysanthemum crop in the United States had a market value of \$131 million (standard mums--\$32 million, pompom mums--\$39 million, potted mums--\$60 million). The domestic supply of cut chrysanthemum flowers is produced mainly in California, Florida, Texas, and Ohio. Potted chrysanthemums are produced nearer to retail markets and there is at least some production in most States.

In addition to domestically produced chrysanthemums, the United States imports about 22 million stems of cut chrysanthemum flowers each year. About 90 percent of these imports come from Colombia with Guatemala, the Netherlands and Mexico also being important suppliers. With the exception of the Netherlands, none of the countries listed as important suppliers have reported the presence of white rust. In the years 1973-1977, plant quarantine inspectors intercepted Puccinia horiana an average of 118 times per year. Six ports (Anchorage, Hawaii, John F. Kennedy Airport, Los Angeles, San Francisco, and Seattle) accounted for 97 percent of the interceptions. Countries of origin include Japan, Singapore, Hong Kong, the Philippines, Republic of China, Korea, and Thailand.

Based on what we know about the biology and epidemiology of chrysanthemum white rust disease, it is likely that if the disease ever gained a foothold in this country, it would cause significant losses to the commercial flower industry. The number of interceptions made annually suggests that there is the real possibility that some diseased material may enter the United States and cause an established infestation. Experience gained with the previous U.S. outbreak and on what is known of the conditions under which the disease was introduced

into other countries suggest that the hobbyist grower presents the greatest potential risk as a site of new infections.

An examination of the measures available for the control of chrysanthemum white rust disease suggests that eradication is a feasible and desirable goal in the case of any future U.S. outbreaks of the disease particularly when the disease is detected early.

2. DISTRIBUTION

The current distribution of Puccinia horiana includes the following countries:

<u>AFRICA</u>	<u>EUROPE</u>
Canary Islands	Austria
South Africa	Belguim
	Denmark
	Finland
	France
	Germany
	Great Britain (Eradication Program Underway)
	Italy
	Netherlands
	Norway
	Poland
	Sweden
<u>ASIA</u>	
Australia	
Hong Kong	
Japan	
Korea	
New Zealand	
Philippines	
Republic of China	
Singapore	
Thailand	
<u>SOUTH AMERICA</u>	
Argentina	
Brazil	

It is likely that the disease may occur in other Asian countries. Unfortunately, the reporting of endemic diseases of ornamental crops in this region has been deficient. Often there is no official record of the disease occurring in a country, even when there is evidence (import interceptions, etc.) of the presence of the disease.

3. HOST RANGE

The genus Chrysanthemum and several allied genera (including Matricaria and Dendranthema) are placed in the family Asteraceae (syn. Compositae), subfamily Asteriodeae (syn. Carduoideae), tribe Anthemideae. The genus Chrysanthemum is a relatively large genus, with over 200 wild and cultivated species being recognized and having worldwide distribution.

The cultivated chrysanthemum had origins in China about 3,000 years ago. There has been speculation that most present-day florists or commercial cultivated chrysanthemum varieties are the result of interspecific hybridization between Chrysanthemum morifolium (syn. C. sinense), and Chrysanthemum indicum and perhaps they also include crosses with several other Chrysanthemum species. The specific epithets C. morifolium or C. morifolium var. sinense are the most widely accepted designations for the commercial or florists chrysanthemum. There has been a recent movement in Europe to substitute the generic name Dendranthema for Chrysanthemum in the case of C. morifolium, C. indica and C. erubescens.

The following Chrysanthemum species have been found to be susceptible to infection by Puccinia horiana:

<u>SPECIES</u>	<u>COMMON NAME</u>	<u>DISEASE SEVERITY</u>
<u>C. nipponicum</u>	Nippon daisy	Light
<u>C. arcticum</u>		High
<u>C. shiwogiku</u>		Moderate
<u>C. pacificum</u>		High
<u>C. makinoi</u>		Light
<u>C. yosinagathum</u>		Light
<u>C. indicum</u>		Moderate
(syn. <u>C. japonicum</u>)	Florists chrysanthemum	High
<u>C. morifolium</u>		
(syn. <u>C. sinense</u>)		
<u>C. yezoense</u>		
<u>C. koreanum</u>	High daisy	Moderate
<u>C. uliginosum</u>		Light
<u>C. boreale</u>		Light

The following Chrysanthemum species have been tested via leaf inoculation with P. horiana basidiospores, and show no disease reaction:

<u>SPECIES</u>	<u>COMMON NAME</u>
<u>C. carinatum</u>	Annual chrysanthemum
(syn. <u>C. atroccineum</u> ,	
<u>C. bicolor</u> , <u>C. burridgeanum</u> ,	
<u>C. dunnetti</u> , <u>C. matricaroides</u> ,	
<u>C. tricolor</u>)	
<u>C. catenche</u>	Crown daisy
<u>C. coronarium</u>	
<u>C. corymbosum</u>	
<u>C. cinerariifolium</u>	Dalmatian pyrethrum
<u>C. coccineum</u>	Pyrethrum, painted daisy
(syn. <u>Matricaria coccineum</u>)	
<u>C. frutescens</u>	Marguerite, Paris daisy

C. foeniculaceum

C. gayanum

C. haradjannii

C. leucanthemum

C. macrophyllum

C. maximum

C. multicaule

C. myconis

Oxe-eye daisy

Tansy chrysanthemum

Shasta daisy

(syn. Myconella myconis)

C. ornatum

C. pacificum

C. segetum

Corn marigold

In summary, the commercial chrysanthemum, C. morifolium, is the only commonly cultivated chrysanthemum species that appears to be subject to infection by Puccinia horiana. All of the other widely cultivated species, annual chrysanthemums (C. carinatum and C. coronarium); Pyrethrum or painted daisies, (C. coccineum); Marguerites or Paris daisies, (C. frutescens); shasta daisies, (C. maximum); and corn marigolds (C. segetum) have not been shown to have any susceptibility to infection by P. horiana.

When considering host ranges, some attention must be given to the possible existence of physiological races of the pathogen (Puccinia horiana). Reports of trials on C. morifolium cultivars have shown wide variations in the susceptibility of a given cultivar to P. horiana isolates from different sources (e.g. South African vs. European isolates). This suggests the existence of at least several physiological races of the pathogen. In light of this, any statements concerning the existence of resistant Chrysanthemum species must be taken with some caution, since, in most cases, the trials being reported involved challenge by a single pathogen isolate.

4. PATHOGEN AND DISEASE

a. Symptoms and Damage: Pale green to yellow spots, up to 4 mm in diameter, develop on the upper surface of leaves. With age, the centers of the spots turn brown and become necrotic. Telia form on the undersides of leaves, appearing first as buff to pinkish, waxy pustules, 2 to 4 mm across. These pustules become prominent, and with the production of basidiospores, become whitish. While infection is most common on leaves, it can occur on any green portion of the plant (stem, bracts, crown, etc.), and also on petals. Infected leaves will often wither, and when infection is severe the entire crop may be lost.

b. The Pathogen: Puccinia horiana P. Henn. is a microcyclic rust. Teliospores are produced in sori (previously described) formed on the undersides of leaves. Teliospores germinate in place, without dormancy, to produce a promycelium which gives rise to basidiospores (sporidia). These sporidia reinfect chrysanthemum leaves, there being no alternate host. Pycnia,

aecia, and uredia are unknown for this fungus. Teliospores are oblong to oblong-clavate, 32-45x12-18 micrometers, slightly constricted, with a pale yellow wall 1-2 micrometers thick. The pedicel is hyaline, persistent, and ranges up to 45 micrometers long. Germination usually results in the production of a single promycelium from the apical cell. The promycelium is about 33x8 micrometers and may be one-, two-, or three-celled. The first basidiospore is always produced at the distal part of the promycelium. The basidiospore is an oval structure with a somewhat rough wall, measuring about 12x6 micrometers. Basidiospores are usually multinucleate when mature.

c. Biology and Epidemiology: Within the optimal infection temperature range of 17° C. to 21° C. (63° F. to 70° F.) average incubation time is about 12 days, with the shortest time observed being 6 days. Incubation time is extended at lower temperatures, and at temperatures above 30° C. (86° F.) symptoms do not develop. When incubation is interrupted by brief periods of low temperature, incubation times have been extended as long as 56 days. Once plant tissue becomes infected, it is possible for the pathogen to overwinter as mycelium in green tissue. This would, of course, occur only in the absence of prolonged freezing temperatures.

Once teliospores have formed, germination may occur within 3 hours. The presence of high humidity and/or free water encourages teliospore germination, which is optimal over a range of 13° C. to 24° C. (55° F. to 75° F.). Light seems to have no effect on the formation or discharge of basidiospores. Once basidiospore have been released, dissemination and germination depend on the presence of moisture. Water splashing is the usual mode of spore dispersal, and free water seems to be necessary for germination of the basidiospore. At optimum temperatures, 5 hours of wet conditions are sufficient to establish new infections on adjacent plants. Under extremely moist or humid conditions, it is possible for sporidia to be dispersed by the wind for distances of up to 402 meters (1/4 mile). Due to the extreme susceptibility of the basidiospore to desiccation, this type of spore dispersal is usually not important.

The maximum survival period of teliospores formed on plant material is 8 weeks. Burial in soil and high humidity both serve to reduce survival time substantially. Teliospore survival in moist soil or compost would most likely not exceed 3 weeks.

d. Control: Control of chrysanthemum white rust disease has been achieved by means of exclusion, sanitation, cultural practices, chemicals, and resistant cultivars. The current absence of white rust in the United States is largely due to the success of quarantine (exclusion) programs. The effectiveness of this type of control program becomes obvious in light of the 80 to 100 successful pathogen interceptions made annually at ports.

Sanitation involves the complete removal of all green tissue from infected plants or from plants exposed to infection. Because *P. horiana* can survive for a maximum of 8 weeks on dead leaves and litter, the elimination of

germination sites for longer than that time will effectively break the pathogen life cycle. This also eliminates incubating infections that have not become apparent. Hot water treatment has proven to be a very effective method of destroying fungal mycelium associated with infected rootstocks that are to be used for subsequent plantings. Immersion for 5 minutes in water at 46° C. (115° F.) will result in the complete destruction of any green tissue and associated fungal mycelium.

Cultural practices which result in disease reduction or elimination involve the management of water and humidity. Since sporidia are dispersed by splashing water and since high humidity and free water are essential for the germination of sporidia, any steps taken to reduce humidity and the presence of free water would be beneficial. This would include lowering the humidity in glasshouses and the elimination of overhead or sprinkler irrigation systems.

Good control of the disease has been achieved using foliar applications of the fungicide Bayleton® or through the use of oxycarboxin systemic fungicides applied to foliage. Use of any of the fungicides mentioned may result in foliar damage.

The use of resistant cultivars as a control method has limited potential in an eradication program. In addition, there is considerable evidence that while host plant resistance is present, it is probably not uniform. It has been suggested, but not yet demonstrated that P. horiana exists as a number of distinct physiological races--some of which may be associated with the geographic distribution of the pathogen.

5. IDENTIFICATION

In addition to Puccinia horiana, only one other rust, P. tanacetii DC (syn. P. chrysanthemi), has been reported on chrysanthemums in the United States. P. tanacetii is the cause of the common or black rust of chrysanthemum. Common rust is widely distributed, and will be the only rust disease from which white rust must be differentiated in any survey program. Common rust is encountered in many hobbyist plantings, and less frequently in commercial plantings. The disease is most common in the fall of the year or where sprinkler irrigation is used.

Separation of P. horiana from the other chrysanthemum rust is not difficult. Since only the uredial stage of P. tanacetii has been reported in the United States, it can be distinguished from this rust and P. horiana using microscopic characteristics as follows:

	<u>P. horiana</u>	<u>P. tanacetii</u>
Sori-color	Yellow to white.	Yellow to brown.
Uredospores	Not present.	Globose to ellipsoid, brown echinulate, 24-52x17-27 micrometers.
Teliospores	Only spore form encountered. Smooth, elongate, yellowish 32-45x12-18 micrometers.	Rare in North America. Finely verruclose, rounded, dark brown, 35-57x20-25 micrometers.

Addendum D--Chemicals

1. BAYLETON®

This fungicide is used in the prevention of rust infections. Bayleton® should be mixed with water at the rate of 1 ounce per 10 gallons of water (0.8 ml per liter). The mixture should be applied to plants as a full coverage foliar spray to the point of runoff. Repeat applications should be made every 2 weeks during the eradication treatment period.

2. PLANTVAX-75 W (OXYCARBOXIN)

This fungicide is used in the prevention of rust infections. PLANTVAX-75 W should be mixed with water at the rate of 2.2 ounces per 10 gallons of water (1.7 ml per liter). The mixture should be applied to plants as a full coverage foliar spray.

Addendum E--Forms

To be added later.

Addendum F--Contributors

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